Systems Evaluation and Assessment (SEA) Sub-element

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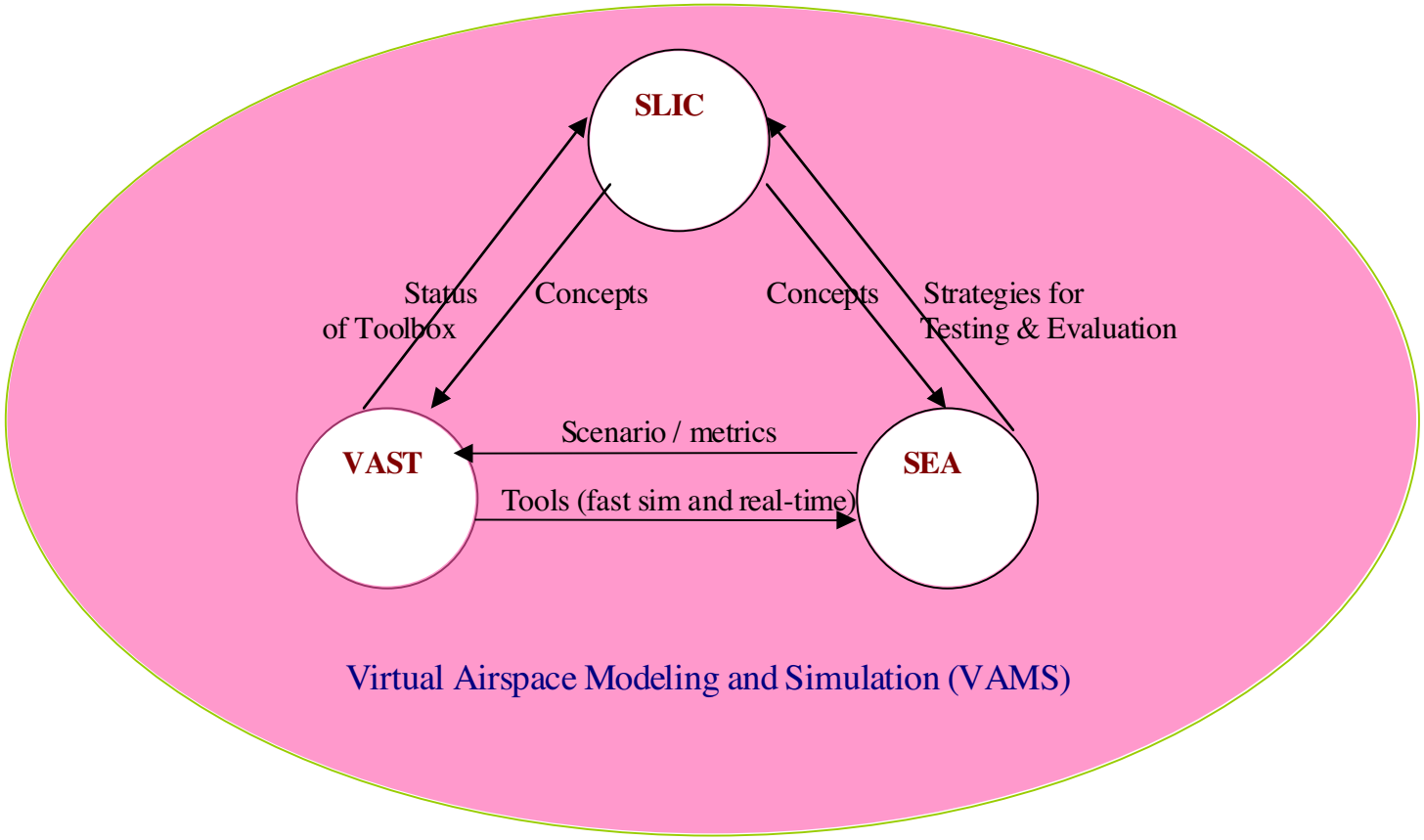
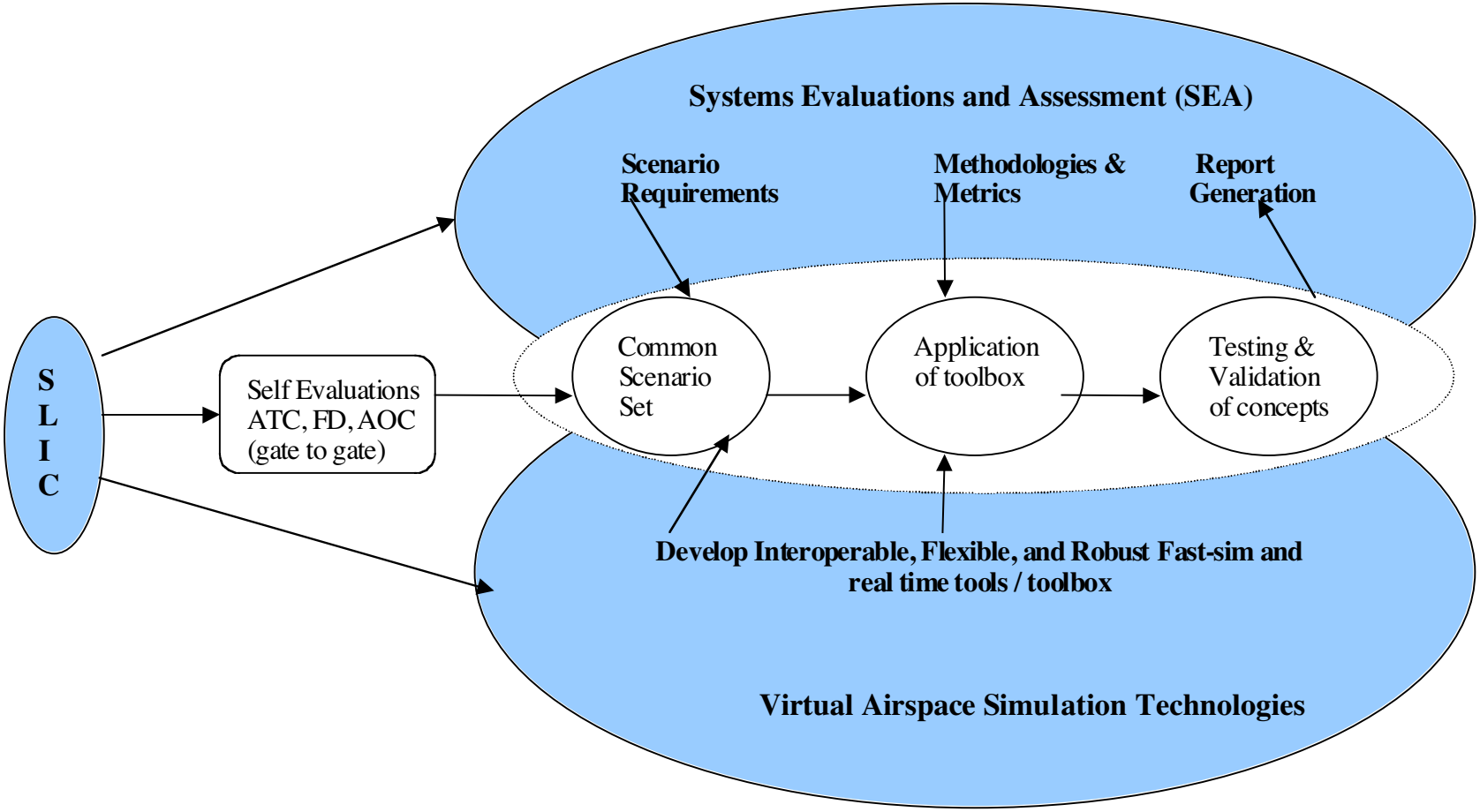
SEA Sub-element

Relationship between the VAMS Sub-elements



SLIC = System Level Integrated Concepts
VAST = Virtual Airspace Simulation Technologies
SEA = Systems Evaluation and Assessment

Relationship between the Sub-elements



System Evaluation and Assessment Technical Challenges

- Identifying and prioritizing a set of existing models
- Developing models to fill gaps
- Integrating and validating the set of models
- Integration with human-in-the-loop simulation and validation

Modeling & Simulation

- Using appropriate evaluation methods
- Defining gate-to-gate and door-to-door measurable metrics
- Supporting and defining appropriate scenarios (utilization)

Evaluation & Assessment

- Identifying Enterprise goal-achieving concepts
- Comprehensive modeling and analysis of concepts and supporting technologies
- Seamless integration of concept elements
- Knowledge management
- Technology/concept assessments
- Information flow

Operational Concept & Analysis

Today's System Evaluation Methods and Techniques

B747-400 Simulator at NASA Ames

Real-Time Link

William J. Hughes Technical Center Lab

Air-Ground Integration Experiment (2000)

Data

- Timing variables
- Closest Point of Approach
- Aircraft maneuvers
- Workload data
- Communication timing
- Cockpit display data
- Alerting logic data

Analysis & Recommendations

Current Evaluation & Assessment Gaps

- High resolution data
- Reflects limited segment of the NAS

System Evaluation and Assessment General Tasks and Goals

- Develop scenarios and metrics for evaluation of the SLIC concepts
- Conduct an initial validation assessment of the VAST real-time tools
- Conduct an initial assessment of the selected concepts
- Conduct an assessment of the integrated concepts
- Conduct the final evaluation of the selected concept(s) using the VAST tools

Scenario/Metric Requirements

- Scenarios and Metrics will be used to help evaluate the concepts from VAMS/System Level Integrated Concepts
  - –Initial evaluation of concepts will be self-evaluation
  - –The scenarios/metrics for self-evaluation can be used to assist the SEA scenario/metric development
- There can be many scenarios and metrics, but ultimately they must be applicable for broad evaluations
  - –Concepts addressing multiple airspace domain and concepts addressing more specific domains
  - –Concepts addressing multiple parts of the triad (AOC/ATC/FD)

Scenario Topics and Issues

- Scenarios are necessary for the evaluation of the "capacity-increasing" concepts
- Scenarios must test the concepts' ability to increase capacity and maintain (or increase) safety
- Scenarios must cover all domains (e.g., surface, terminal, enroute)
- Scenarios must consider normal and non-normal events
- Scenarios must cover real-time and fast-time testing
- Scenarios must test all parts of the NAS triad: AOC, ATC, flight deck
- Scenarios must be able to test both single-domain concepts and more broad concepts
- SEA is writing requirements for the scenarios, not the scenarios themselves.

Framework for Scenario and Metrics Development*

concepts → **operational scenarios** → **NAS Model** → **output metrics** → **evaluation metrics**

Stakeholder Viewpoints (questions to be answered) → operational scenarios

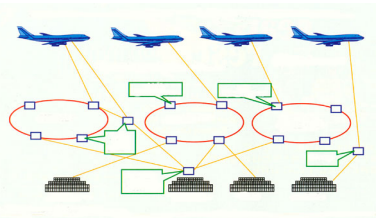
Stakeholder Viewpoints (questions to be answered) → evaluation metrics

1. Scope:
- issues
- NAS Domain
- challenges
- assumptions

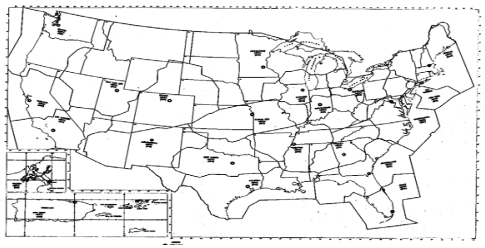
2. Top Level Descriptions:
- core ideas
- functions

3. Detailed Descriptions:
- performance
- roles, responsibilities
- @ humans & machine
- human factors
- user interfaces

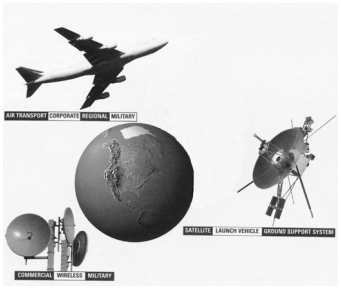
4. NAS infrastructure & technology impacts:
- transition planning
- architecture
- technology requirements



Scenario Elements:
- NAS Domain
- NAS Perturbations (e.g. Wx, Security Incidents)
- Origin/Destination Demand
- Assumed Technologies
- Human/Machine Performance
- Defined ATM Procedures
- Assumed Equipage
- Fleet Mix
- Etc.



Simulations



Empiric Analysis
(i.e. expert opinions)

- Number of traffic events (takeoffs, sector crossings, landings, etc.)
- Number of communication events (requests, clearances, directives, etc.)
- throughput (traffic volume)
- Delay
- Safety incidents (proximity to minimum separation, incursions, encroachments, etc.)
- Elapsed flight times
- Fuel burn
- Capital investments
- Personnel workloads
- Etc.

- Average aircraft flight time per air route*
- Average aircraft payload per flight mile
- Operational cost per passenger mile
- Average taxi time from pushback to wheels up during peak traffic periods per specific airports or taxi paths within airports
- Average voice channel occupancy time per departure from pushback to take off
- Average Airport arrival rate during peak periods
- Rate of arrivals per controller hour per airport
- Aircraft (or engine, or other component) maintenance costs per flight mile
- Etc.

* a defined city pair air route

*Viewgraph from Jack Perkins, Volpe Center

System Evaluation and Assessment Team Members

- San Jose State University
- Volpe Transportation Systems Center
- Seagull Technology, Inc.
- Monterey Technologies, Inc.
- Researchers within NASA